

THE WINTER OF 1918-'19 AND THE ACTIVITIES OF
INSECTS WITH SPECIAL REFERENCE TO THE
CLOVER LEAF-WEEVIL
(*Hypera punctata* Fab.)

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Our knowledge of the factors governing the ability of insects to pass successfully through any given winter conditions is very meager. Apparently some winters are very destructive to insect life and bring about a high mortality in the stages that attempt to survive this period while other winters are favorable to the survival of the eggs, larvæ, pupæ, or imagos as the case may be. The winter of 1918-1919 was certainly a very open and abnormally warm one all over New York State; but it is apparent, from studies made regarding the effect of heat and cold on insect life, that the comparative degrees of humidity, as well as of temperature, must be taken into account if correct generalizations are to be made. For example, as Pierce¹ says: "A creature which can stand a certain degree of cold at a given humidity may be absolutely unable to stand that same temperature at another degree of saturation or relative humidity." Thus there have arisen conflicting interpretations of climatic effects on insects made by different investigators in different localities because they were working under very different degrees of humidity of which no account was taken. It will perhaps not be out of place to give a brief summary of the weather conditions from November to April inclusive as recorded by the weather station at Cornell University:

NOVEMBER, 1918.

"Weather conditions throughout November, 1918, were warm and pleasant, for the most part, with average temperatures generally above the normals in all sections, but the month was a very dry one in all districts, except at few points in the northern part of the State."

DECEMBER, 1918.

"Reports from all sections show that the month was unusually mild with an average excess of warmth of about four and one-half degrees, which is in marked contrast to the severe December of a year ago. A brief spell of zero weather was experienced in the Adirondacks during the first week and again in the northern counties during the

closing days, but otherwise conditions were generally mild and favorable for all forms of outdoor work. Snowfall and precipitation amounts were generally below the normals but were well distributed."

JANUARY, 1919.

"Weather conditions throughout the month were exceptionally mild, as a rule. Two cold spells occurred during the first half of the month, the temperature falling to -20° to -27° in the Adirondack region on the 10th, 11th and 12th, while in the southern and south-eastern sections it ranged from 9° to about -15° . Fortunately the ground was fairly well covered with snow during these severe cold spells, affording a fair to good protection to winter grains, meadows, and new seeding. After the 15th the ground was generally free from snow in most sections, but the temperature average was abnormally high for the season. * * * * Precipitation and snowfall amounts were below the normals at all but a very few stations and pleasant overhead conditions usually obtained."

FEBRUARY, 1919.

"February, like January, was above the normal in temperature and below normal in precipitation. With the exception of 1915 when the temperature averaged 0.3° higher, this was the warmest February since 1891, while precipitation was below normal in all sections, the average of 1.89 inches being the least recorded in the month of February since 1907."

MARCH, 1919.

"The weather of March, 1919, was somewhat above the average both in temperature and precipitation, the excess being 3.4° and 0.56 of an inch respectively. The temperature was above normal in all sections of the State. * * * * The precipitation was above normal in all sections except the Western Plateau and the Mohawk Valley, where it was slightly deficient."

APRIL, 1919.

"The month as a whole, while somewhat colder than the average April, was remarkable for two decidedly cold periods of three days each. The first period covered the first three days of the month, and the second occurred from the 25th to 27th inclusive. The month opened decidedly cold for the season with maximum temperatures generally but little above freezing and minimum temperatures approaching zero in the more elevated parts of the State. * * * * The monthly precipitation for the State was considerably above average."

The weather conditions for the winter of 1918-'19 in New York State may be summed up then as being *above the normal* in temperature and somewhat *below the normal* in precipitation and what is probably as important as either of these there were no

extremes of temperatures except two short cold spells in January when the ground was fairly well covered with snow.

Another factor that must be taken into consideration in any account of the activities of insect life during the season of 1919 is the character of the climatic conditions of the summer following the winter of 1918-1919.

The summer of 1919 was one of normal averages for the months of July and August although there were extremes in July largely because the thermometer went very low at one period. May was nearly normal in temperature but the precipitation was above the normal while June was a month of abnormally high temperatures with precipitation somewhat below the normal and this may have favored the early increase of insects. As a whole, the summer, from a human standpoint, was pleasant and comfortable and a very favorable one for crop production.

The writer is well aware of the danger of making generalizations regarding this phase of insect life. The factors are too involved and there are too many conflicting conditions to make possible any extended generalizations. It is rather commonly held, I think, that insects can better withstand winters with steady low temperatures than seasons of sudden, wide, periodic fluctuations of temperature. We shall probably find, when we have sufficient accurate data, that insects can best withstand winter or summer conditions of even or equable average temperatures accompanied by certain optimum conditions of humidity.

There have been seasons when one or two insects, like the army-worm, May-beetles, rosy apple aphid and green apple aphid have been very abundant but as the author looks back over the last half-dozen years he does not recall a season within that period certainly when so many different species of insect pests were so generally prevalent and destructive as during the past summer. For example, the red-legged grasshopper, *Melanoplus femur-rubrum*, was abundant and destructive over a large part of the State. Say's blister beetle, *Pomphopæa sayi*, appeared in destructive numbers from Utica to near Buffalo. The little black and red Hemipteron, *Cosmopepla carnifex*, a weather barometer apparently, appeared in enormous numbers in several localities. The wheat midge, *Contarinia tritici*, was abundant and injurious over the whole State, while the green

clover worm, *Plathypena scabra*, occurred from Long Island to Lake Erie and was destructive to vegetables. The old-fashioned potato beetle, *Lema trilineata*, came into prominence for the first time in many years while that other increasing potato pest, the potato leafhopper, *Empoasca mali*, was present in injurious numbers in many localities. The pear slug, *Eriocampoides limacina*, became abundant in certain regions and, in one instance at least, nearly defoliated five acres of cherry trees. The lined corn-borer, *Hadena fractilinea*, scarcely heard of since Webster discussed it in 1894, appeared generally over the State and caused considerable injury. Other examples might be mentioned, but we wish to speak more specifically of the clover leaf-weevil, *Hypera punctata*, and its activities in the spring of 1919.

In some localities the clover leaf-weevil had evidently passed the winter very successfully and in large numbers, and what interested me most regarding it was the numbers of fresh active adults that we found in the fields in the spring. The larvæ were abnormally abundant in many fields in the State and in one or two localities bid fair to cause serious injury. On a farm near Warsaw, N. Y., in a field of eight acres of clover sown the year before to wheat, the larvæ occurred in enormous numbers and for a time devoured the clover about as fast as it grew. On May 17 I visited the field and found the larvæ in all stages of growth although many were nearly full-grown. From six to eight grubs were present at the base of each plant but the conspicuous thing about them at this time was the large numbers of individuals that were dead or dying from the attacks of the fungus *Empusa sphaerosperma*. The sick larvæ had climbed the blades of grass, stems of clover, and stubble of wheat around which each had curled in the characteristic horizontal position. The larva would turn white at first but later would become green and soon die. The progress of the larvæ and of the disease to which they were subject was watched by D. S. Dilts, Assistant Farm Bureau Agent. He informs me that the grubs were so effectively checked by the fungus that they caused no material damage after the middle of May and that the clover recuperated from the early injury and made a fine growth. Similar conditions were observed here at Ithaca. Other observers have recorded the effectiveness of this fungus in holding the larvæ in check in seasons of abnormal abundance. For instance, Folsom²

says "the reported outbreaks of the larvæ in spring have almost always been suppressed by the virulent disease just described (*Empusa*). This disease prevents the summer damage by the beetles, often killing the larvæ before they have done much injury."

Perhaps the most striking feature regarding the weevil was the number of adults that came through the winter in an apparently active condition capable of procreating the species. It is generally supposed that the weevils, although they may survive the winter, are not capable of any activity in the spring. Indeed all that I have ever found hitherto in the spring have been more or less covered with dried mud and were weak and apparently incapable of effectual activity. On this point Folsom³ says: "I have rarely found the beetles in the early spring, and such as were found were either dead or in the last stages of decrepitude, and evidently incapable of doing anything toward the propagation of their kind."

My attention was first called to these adults by Mr. J. D. Detwiler, who was in the field searching for species of some lesser clover weevils on which he is now working. On March 26 he brought in three adult weevils which were fresh and clean of dirt and active in movement. On succeeding days we were able to find more adults in similar condition. It seems probable that the weevils were similarly abundant and active in the spring in clover fields throughout the State. These beetles were placed in a cage until other beetles were collected in the next few days and on April 5 cages were made ready and the beetles placed in them. The weevils were furnished with fresh clover plants and pieces of old clover stems to provide hiding places for possible eggs. On April 7 I found seven fresh eggs in a hollow clover stem. In another cage, also on April 7, I found one egg on the stipule of a leaf. All of these eggs were removed and placed in shallow tin boxes but owing to dryness, I think, every one of them shriveled and failed to hatch.

On April 19 a group of nine or ten fresh eggs was found again in one of the cages. Again they were deposited in an old hollow stem of clover. These eggs hatched on May 6 or 7. I am not sure which, because at my last examination on May 5 they had not hatched and owing to my absence I did not see them again until the morning of the 8th, when all had hatched. From these eggs I isolated several larvæ, placing each in a shell vial

where they could be watched and fed. Later, when the larvæ became of some size each was transferred to a shallow tin box.

On April 21 I found another batch of nine eggs in a hollow clover stem. Unfortunately, in my desire to watch these closely I opened the stem and later the eggs became scattered in the cage. Those that I could find, however, hatched about May 7. Another batch of eggs found sometime after deposition hatched May 18. In all, four or five batches of eggs were obtained from these beetles.

The lives of the larvæ placed in vials, and later in tin boxes, were somewhat checkered, as one died within a short time, another after the first molt and a third after the second molt. Three, however, came through but one pupated, without spinning a cocoon, on June 8 (I found this to be quite a common occurrence in the tin boxes) and the beetle died without emerging. Another spun a cocoon on June 8 and the adult emerged June 20. This gives a period from egg to adult of 44 or 45 days, depending on whether the eggs hatched May 6 or May 7. A third pupated naked on June 14 and the adult emerged June 20.

From eggs in another cage found May 5 and that hatched May 18, I isolated three larvæ of which one died while two passed through their cycle and both pupated on June 14, while the weevils of both appeared on June 20, only a few hours apart. This would give a cycle of 46 days (from May 5 to June 20).

The vicissitudes of breeding experiments are many, especially where an attempt is made to isolate each larva and to rear it under abnormal conditions. If the larvæ had been left in the cages in more normal environments they would probably have come through more successfully. Indeed, in one of the cages in which I failed to find the eggs and therefore did not remove them the larvæ thrive much better. In view of the foregoing facts regarding egg-laying and development of the weevils the question of a possible second generation presents itself.

Riley⁴ who first investigated this insect in 1881 and '82, says: "This fact, together with the other well-known fact that the Rhynchophora in the imago state are often long-lived and do not begin ovipositing immediately after maturity leads us to believe that there is normally but one annual generation." He qualifies this statement later, however, by saying that "our notes and observations as here recorded would indicate that a second generation may exceptionally occur," and suggests that this might

happen in the latitude of Washington, D. C. Folsom³ says: "In central Illinois we have only one annual generation of this insect, as seems to be the rule elsewhere," and later he also says: "In a warmer latitude than this there might very well be a second generation of beetles, to hibernate and lay eggs the following spring."

It seems to me that our observations and breeding experiments show fairly conclusively that the clover leaf-weevil may survive favorable winters and become active enough in the spring to deposit eggs thus producing exceptionally a second generation in central New York. It will be recalled that November of 1918 "was warm and pleasant for the most part" and that "December was unusually mild with an average excess of warmth of about four and one-half degrees." These conditions may well have given opportunity for many of the larvæ to have reached maturity in the fall and to have transformed to beetles which found favorable weather conditions, during January, February and March. Thus they were able to pass the winter without impaired vitality and deposited eggs in the spring. Moreover, these observations, it seems to me, indicate strongly that farther south where the winter conditions are habitually more favorable, there may be normally a second generation of the weevils.

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